which color blood serum, may be misleading unless it is controlled by the van den Bergh test or some other specific test for bilirubin; (4) that the van den Bergh test is an aid to the differentiation between obstructive and non-obstructive jaundice, in which respect the icterus index is of no assistance.

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DISCUSSION

ROY W. HAMMACK, M. D. (1003 Pacific Mutual Building, Los Angeles)—Doctors Segall and Terry have given us an interesting and instructive comparison of these two tests for bile pigment in the blood. All will agree, I believe, that the van den Bergh test gives us more information than the icterus index though at the cost of somewhat more effort.

I was surprised to see in the report so many instances of high icterus index in which the presence of bilirubin was not shown by the van den Bergh test. This emphasizes the importance of controlling the high icterus index by a specific test for bilirubin. Provided it is so controlled I believe that the icterus index is a more accurate quantitative test and is more easily performed than the quantitative van den Bergh.

Our knowledge of jaundice has been greatly increased by the study of the blood by these methods and this compartive study is no small contribution to that knowledge.

❦

CHARLES L. BENNETT, M. D. (607 South Hill Street, Los Angeles)—This paper by Segall and Terry calls attention to a particularly valuable quantitative test for bilirubin in the blood stream. Jaundice means increased bilirubin in the blood, and the proper interpretation of the amount and kind means much in exact diagnosis of forms of anemia and obstructive diseases of the biliary ducts. The indirect test is always positive when bilirubin is present in the blood stream and is valuable in differentiating pernicious anemia with its extensive destruction of red blood cells. When bilirubin passes through the polygonal hepatic cells its molecular structure is changed and here the direct van den Bergh test is positive and, when present, indicates resorbed and molecularly changed bilirubin due to biliary duct obstruction. Attention should be called to the fact that jaundice of the "invisible variety" (*i. e.*, before becoming evident to ordinary sight) can be diagnosed. Also the van den Bergh is not a mere color test as is the icterus index. The latter gives a positive reaction with other pigments, while the van den Bergh is a definite chemical reaction for bilirubin, with all the advantage accruing from the fact that it cannot be confounded with any other substance. This paper is timely in its emphasis of a specific procedure, harmless for the patient, and simple for the clinician.

❦

ARTHUR L. BLOOMFIELD, M. D. (Stanford University School of Medicine, San Francisco)—Doctor Segall's and Doctor Terry's observations are in accord with those of other workers. In regard to the value of the two tests for the detection of hyperbilirubinemia there is now quite general agreement that the van den Bergh is more delicate and accurate. Whenever this can be performed it is undoubtedly the method of choice, and the icterus index should be reserved as a simpler and a less accurate method. The technical difficulties connected with the van den Bergh test are, however, considerable, and unless the procedure is performed with the greatest care, it may be more satisfactory to employ the simpler though less accurate method.

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DOCTOR SEGALL (closing)—Regarding the relatively large number of cases showing a high icterus index as against no abnormal quantity of bilirubin by the van den Bergh test in the same case, this is precisely what we want to bring out: that the van den Bergh test is a specific qualitative and quantitative test for bilirubin. The icterus index is not specific for bilirubin. The only way possible at present to correct misleading returns by the icterus index method, is by use of the van den Bergh test, properly done. We therefore consider the icterus index as less accurate. As to technical difficulties in doing the van den Bergh test, we have been able to overcome them.

LIPIODOL—ITS USE IN PULMONARY SUPPURATONS*

By E. RICHMOND WARE, M. D.
Los Angeles

DISCUSSION *by William C. Voorsanger, M. D., San Francisco; Ernest H. Falconer, M. D., San Francisco; A. L. Bramkamp, M. D., Banning.*

A SATISFACTORY clinical and anatomical diagnosis in a large number of suppurative conditions of the lungs has always been a difficult problem. Lung abscess and bronchiectasis are frequently suspected from the history alone, and physical and routine roentgenological examinations usually give valuable additional information. However, the accurate localization of the pathology and the discovery of all the involved areas have often been impossible, with the result that attempts at treatment by the various methods at our command have not been very encouraging. In lipiodol, or iodized oil, we have a non-irritating fluid substance which can be safely introduced into the tracheobronchial tree. It is opaque to the x-ray and will clearly demonstrate the outline of intrapulmonary cavitation in the bronchi themselves, or in the various portions of the lung parenchyma which have direct connection with the larger bronchi.

LIPIODOL

Lipiodol is a golden yellow, oily substance, fairly viscid, becoming more fluid at body heat, with a content of 40 per cent metallic iodin. The iodin is in a close combination with the oil of poppy seed and fails to give the usual starch reaction. It has a characteristic odor, and on standing undergoes decomposition, with the liberation of free iodin, as indicated by the appearance of a brownish tint. Such a specimen is unfit for use.

HOW LIPIODOL IS USED

In addition to its use in the respiratory tract it has been employed to demonstrate the spinal canal, the vas deferens, the seminal vesicles, the patency of the fallopian tubes, the size and character of

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the sinuses of the head, and the course of various tracts connected with areas of chronic suppuration, as well as cold abscesses in numerous locations. Its introduction into the bronchial tree can be by the supraglottic, transglottic, infraglottic, or bronchoscopic route. The transglottic and infraglottic methods have not been employed in any of the cases of this series. It seems hardly necessary to introduce a catheter between the vocal cords as is necessary in the transglottic method; and the infraglottic approach pierces the cricothyroid membrane and injects the oil directly into the trachea by means of a curved metal cannula similar to the type used in abdominal paracentesis. The supraglottic method has been employed in the greatest number of cases, and causes very little inconvenience to the patient. After moderate local anesthetization of the pharynx, vocal cords, and upper portion of the trachea, the lipiodol is slowly dropped upon the open glottis during inspiration. If the patient refrains from coughing or swallowing, it readily descends the trachea and will enter the most dependent portion of the lung. Fortunately most of the diseased area is located in the lower lobes, and the area to be filled can be selected by tilting the patient to the involved side. The upper lobes may be fairly well demonstrated by tipping the table so that the head is lowered and the feet elevated. The amount used varies from 10 to 35 cc., and it is best to attempt to fill no more than two lobes at a single sitting. A roentgenogram should be taken at once, before the patient has coughed. Lateral or oblique as well as anteroposterior views should always be included. The bronchoscopic method has given us some of our best pictures, especially in cases where a large cavity exists. It has the advantage of introducing the lipiodol directly into a specific bronchus, permits a view of the mucous membrane and allows the aspiration of pus or mucus, which often acts as a plug in the very tube which one is most anxious to outline. However, the passage of a bronchoscope, even in the most skillful hands, represents an ordeal for the patient, and its use must be confined to a small group of highly trained men. I feel that satisfactory results can be obtained by the simpler supraglottic injection in almost all cases of bronchiectasis. However, in lung abscess it is frequently impossible to get a proper filling by the supraglottic method, when a very good result may be obtained by the use of the bronchoscope.

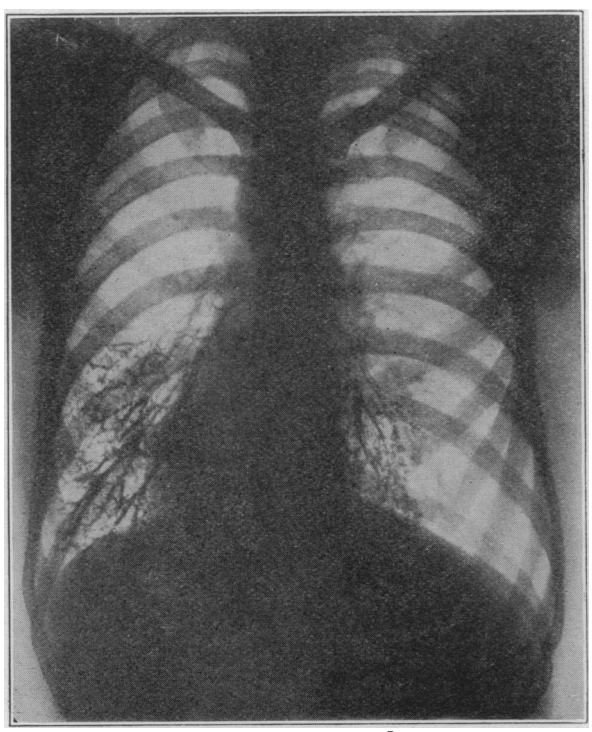

Fig. 1—Lipiodol injection of both lower lobes. Normal picture.

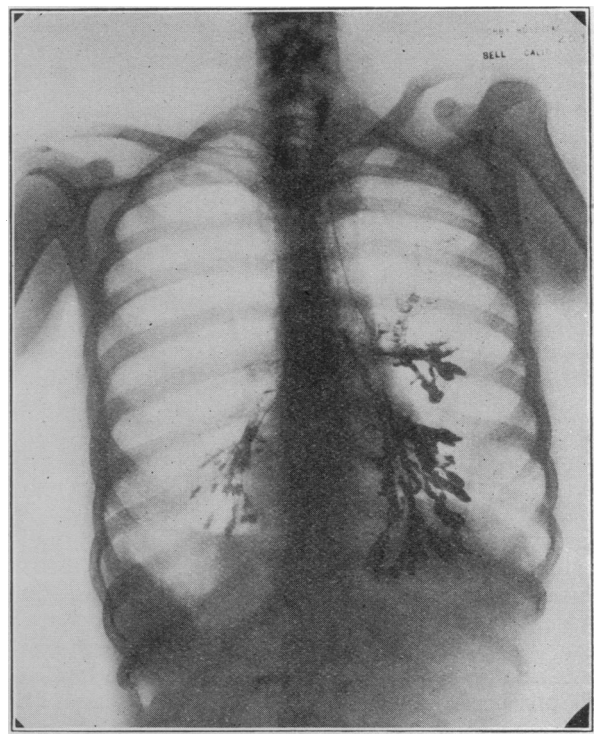

Fig. 2—Lipiodol injection of both lower lobes. Extreme degree of bronchiectasis. Bronchiectatic cavities filled with lipiodol. Trachea well outlined, giving the so-called "bunch of grapes" appearance. (Courtesy of Dr. O. H. Homme.)

CHIEF DIAGNOSTIC VALUE

Lipiodol's chief diagnostic value is seen in suppurative conditions such as bronchiectasis, lung abscess, and empyema. It has also been used to determine the extent and value of lung compression by pneumothorax or thoracoplasty, as well as to locate any additional pathologic areas in cases of pulmonary tuberculosis. It must be remembered that a large part of the pulmonary field at the left base is obscured by the heart shadow; also, the diaphragm outlined radiologically indicates merely its extreme center and highest portion, as it is actually a true dome, higher in the center than peripherally. There is a considerable amount of pulmonary tissue which contains numerous fair-sized bronchial radicles below the level of the outline of the diaphragm. Fairly extensive disease may be present in this area as well

as behind the heart and yet not be suggested in the average stereoscopic plate of the chest.

The normal bronchial outline, when filled with lipiodol, can best be described as a tree with its single large trunk breaking up into smaller branches, which terminate in the spotty foliage represented by the alveoli. The large trunks usually are not filled solidly, but their walls are outlined by two parallel lines which, in the smaller bronchi, are fused into a solid column. This in turn breaks up into sharply outlined linear shadows that terminate in the speckled and splotchy areas of the lung parenchyma. Coughing expels a part of the oil from the bronchi into the alveoli and results in interruption and breaking of the solid bronchial columns. The lipiodol disappears quite rapidly from the bronchi themselves, but remains for several weeks and sometimes two or three months in the alveoli. Here it loses its dense and sharply outlined shadow and often has an appearance very suggestive of a diffuse and active pulmonary tuberculosis, frequently resembling a miliary infection. The lymphatic drainage of the oil toward the glands at the hilum occasionally gives them a very dense shadow in the picture which may suggest calcified glands at the lung roots. Such pictures might well give an erroneous interpretation to a chest plate if the observer were unacquainted with a history of lipiodol injection.

The earliest indications of bronchiectasis are a widening of the bronchial columns, which become fusiform in shape. These later take on a bulbous character, and in extreme cases have a so-called glove-finger appearance. Occasionally the shadow of several closely associated bronchi looks like a cluster of grapes. These are frequently superimposed upon each other to give the appearance of a single large cavity. However, if views are taken in more than one plane this mistake may be avoided. Cylindrical and large sacculated cavities are other characteristic types of advanced bronchiectasis.

Large abscess cavities are frequently not single, and bronchiectasis is often an associated complication. This explains the not uncommon failure of a cure following the aspiration and drainage of a cavity. A type of abscess which is difficult to demonstrate either by the usual roentgenogram or by lipiodol injection is the narrow-necked abscess described by H. C. Ballon. Here the sputum represents merely an overflow, and the actual cavity is probably never completely emptied. However, some of these cases can be injected if bronchoscopic suction is employed before filling with the oil.

LIPIODOL IN PULMONARY TUBERCULOSIS

There is a difference in opinion as to the advisability of injecting lipiodol in cases of pulmonary tuberculosis. Most authors have avoided its use in these cases, but it has been frequently employed in Archibald's clinic, and Ballon endorses its use in certain types of cases. All agree that it should be avoided in toxic cases of pulmonary tuberculosis, with progressive lesions of the exudative type. In patients with good fibrosis, oil injection may be advisable to determine a supplementary bronchiectasis that is often unsuspected and may be responsible for a large part of the persistent catarrhal symptoms. Sometimes cavitation or bronchiectasis that has not been collapsed by a thoracoplasty can be demonstrated and localized by lipiodol, permitting further operative procedures to close the remaining areas of suppuration. In one of our cases the oil produced a definite increase in cough and expectoration, with the appearance of tubercle bacilli in the sputum. These had never been found previously in a long series of examinations. However, the increase in symptoms persisted only a few weeks and was not permanent. Many cases of advanced pulmonary tuberculosis have dilated bronchi and secondarily infected cavities, which may not be seen in the usual roentgenogram. The presence of such infection in the opposite lung would be a distinct contraindication to compression by pneumothorax or thoracoplasty, and might be brought out only by lipiodol injection.

If there has been a recent lung hemorrhage from tuberculosis or from any other cause, injection should be postponed for at least a week. I have seen no serious results from lipiodol, and any toxic absorption can usually be traced to swallowing during supraglottic injection or to ingesting some of the coughed-up oil which has already entered the pulmonary passages. Doctor Pritchard of Battle Creek reported in a personal communication that he had seen two cases of severe diarrhea which followed the use of 40 cc. We have had one case of diarrhea after 30 cc. were injected in a patient who had a larve cavity in addition to bronchiectasis. This lasted for about two weeks, but was accompanied by a concomitant improve-

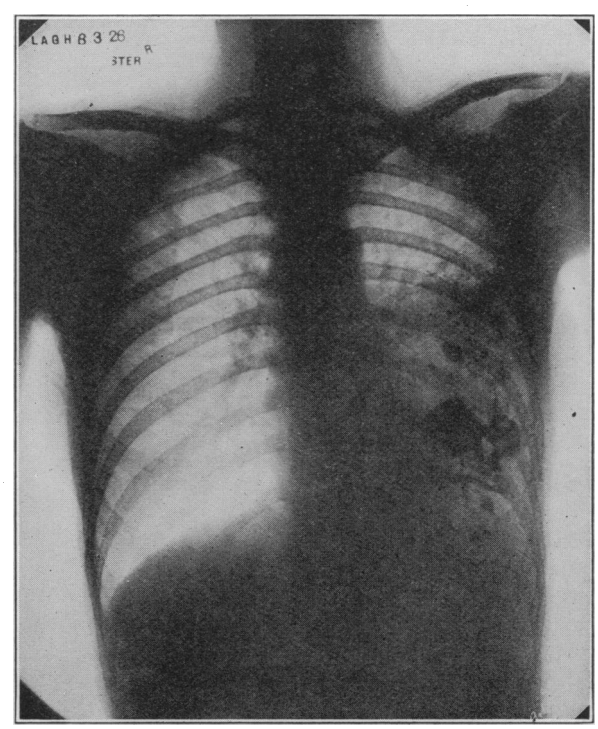

Fig. 3—Intercommunicating bronchiectatic abscess cavities outlined by lipiodol in left lower lobe. Extensive surrounding pneumonitis.

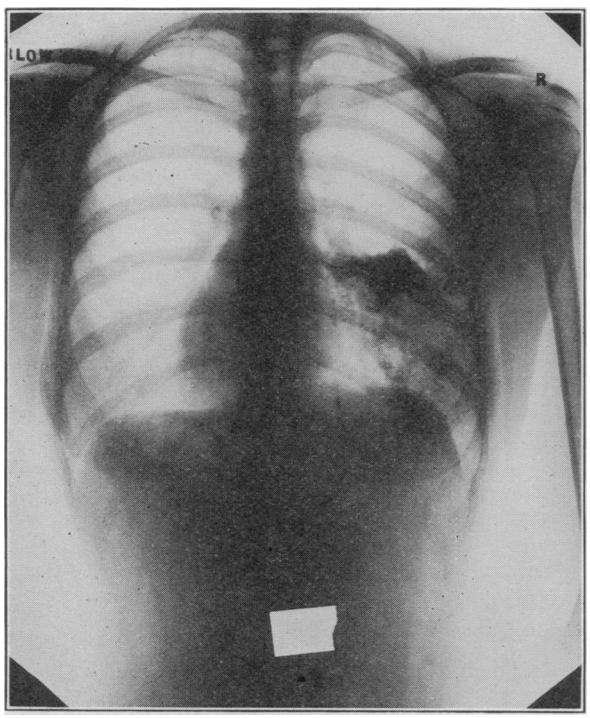

Fig. 4—Cavity filled with lipiodol thought to be non-tuberculous. Following injection tubercle bacilli appeared in sputum. None found previously.

ment in every other respect. I have read of two patients developing headache, malaise, coryza, and conjunctivitis, and an occasional morbilliform rash has been reported. The only two fatalities I have been able to discover were due to myocardial failure in one instance, and in the other the lipiodol was injected in a patient seriously ill with an exudative type of tuberculosis. On the whole, disturbing or alarming reactions have been extremely rare.

COMMENT

Lipiodol was first used purely for its diagnostic value in demonstrating the character and position of cavities and sinuses in various areas. However, it is becoming evident that it has decided therapeutic properties. We have had striking examples of this, and are employing it in cases of bronchiectasis with injection at intervals of one or two weeks. The patient mentioned above, in whom lipiodol produced a persistent diarrhea, showed a definite and unexpected improvement following a single injection, which demonstrated a large cavity with several smaller bulbous bronchial enlargements. From a progressive septic state the entire picture changed, with a disappearance of fever, leukocytosis, and anemia, reduction of cough and sputum, and a progressive gain in weight and strength to normal. Enough time has not elapsed to gauge the full value of lipiodol in the treatment of lung suppurations. In well-established lung abscesses of considerable size there can probably be very little therapeutic result; however, it is evident that it is of undoubted value in cases of multiple bronchial dilations which are not too extensive. Heretofore the outlook for these patients has not been encouraging. Pneumothorax and phrenecotomy have not been satisfactory, and thoracoplasty is a radical operation with high mortality and attended by considerable permanent deformity. All of these three procedures are applicable to unilateral cases only. Postural drainage and change of climate have been about the most successful recommendations we have been able to offer. In lipiodol we have a remedy which is safe and, in addition to its diagnostic value, seems to possess very striking therapeutic properties.

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DISCUSSION

WILLIAM C. VOORSANGER, M. D. (490 Post Street, San Francisco)—Lipiodol or iodized oil, first introduced by Siccard to diagnose lesions of the spinal cord and then popularized by Forestier in pulmonary conditions, has proven a valuable diagnostic aid. I am glad to hear Doctor Ware deprecate the transglottic method, although I have seen Forestier use this method without any discomfort to the patient. It requires skill and practice, however. Armand Delille uses the small canula in children, piercing the cricothyroid membrane without discomfort to the patient. Chevalier Jackson, expert with the bronchoscope, employs this instrument in the use of lipiodol. I agree fully with Doctor Ware that lipiodol can be introduced very easily with a straight canula attached to an ordinary 20 cc. syringe, often by simply anesthetizing the pharynx. This method requires but moderate skill, and practice and excellent roentgenograms can be obtained with it. In localizing lung abscess I would suggest first doing a partial pneumothorax and then introducing lipiodol. In this way the clear and more definite walling off may be obtained.

I cannot agree with Doctor Ware that lipiodol is of any diagnostic value in pulmonary tuberculosis. It rarely, in this disease, gives any information not obtainable by x-ray plates and may cause great damage, particularly in inducing hemorrhage. Lipiodol has been of great aid in demonstrating bronchiectatic cavities and dilated bronchi back of the heart shadow, and should be primarily reserved for non-tuberculous pulmonary conditions. Doctor Ware's observation that no serious results ensue from the use of lipiodol coincides with the opinion of most men who are using it routinely. Toxic absorption usually happens when lipiodol is swallowed, the oil disintegrating in the stomach and liberating iodin. If the stomach is fluoroscoped after the introduction of lipiodol we can readily see if any has been swallowed and if so by immediately washing it out prevent absorption. Lipiodol often stays in the lung tissue months or years without apparent damage.

Regarding the therapeutic value of iodized oil reports to date are anything but conclusive. Armand Delille in treating bronchiectasis in young children has noticed a definite cessation of cough after the introduction of lipiodol. This may be due to the filling of a small cavity with thin walls. If the oil is retained long enough the cavity may close. This would hardly apply to the bronchiectatic cavity of an adult where the walls are much thickened. I have personally never seen a definite therapeutic effect which could be attributed to lipiodol *per se*. Still it has possibilities, and we should observe experiments in its use with open minds and unbiased judgment. Doctor Ware has presented this entire subject in an excellent manner, and no doubt his experiences will stimulate a wider use of this valuable diagnostic method.

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ERNEST H. FALCONER, M. D. (384 Post Street, San Francisco)—Lipiodol has now been in use long enough to enable one to know something of its limitations, as well as its possibilities. About one year ago, when in Montreal, I saw some films of cases that had been injected by H. C. Ballon with the bronchoscopic method. These films outlined bronchiectatic dilatations that had been entirely missed by the supraglottic

method. Success in certain cases undoubtedly requires the use of the bronchoscope, plus skill in its use. The supraglottic method, on account of its simplicity, has a much wider range of usefulness.

Doctor Ware has covered the uses of lipiodol well, also pointing out that it is toxic in an occasional case. As a result of the widespread use of this agent we are getting an increasing number of reports of toxic reactions, some of them quite severe.

As to the therapeutic value of lipiodol in pulmonary suppurations, opinion seems much divided. I do not feel at this time very much encouraged over its therapeutic possibilities. One should, however, await more data on this particular phase of its use.

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A. L. BRAMKAMP, M. D. (Banning)—The use of the x-ray, especially stereoscopic, in the diagnosis of the chest condition marked a great advance. For one thing, it showed some of the limitations of physical examination. In the use of these two methods of examination, x-ray and physical, however, each is a check on the other, and best results follow the judicious use of both. Introduction of the method of lipiodol injection into pulmonary areas for diagnostic purposes has carried diagnostic efficiency still further, and has demonstrated additional limitations not only in physical examination of the chest, but has also shown surprising limitations in even the stereoscopic x-raying of the lungs; particularly as to conditions below the top of the diaphragm and behind the heart. There is now to be had assurance as to actually existing conditions in the pulmonary area where formerly guesswork obtained to a considerable extent. Even the most skilled in physical examination and in x-ray find the possibilities of definite diagnosis in certain cases wonderfully extended. All this has been brought out in Doctor Ware's excellent paper, and in previous discussions.

As to methods of introducing lipiodol, or any substance that may displace it, into the lungs, it would seem the bronchoscopic method comes nearest being the ideal, since it makes possible most certain and accurate placing of the opaque substance.

However, if the use of lipiodol is to find the general and perhaps frequent application to which it now seems entitled, some method or methods requiring less special equipment and training must be available. This need seems to be met in the supraglottic and the transglottic methods, which the training of any throat or chest specialist and that of many other practitioners enables them easily to master, and which gives excellent results.

The possibilities and limitations of lipiodol injections are rapidly being established. There are also suggested possibilities of its therapeutic value.

As to the use of lipiodol in cases of tuberculosis, Archibald, Iglauer, Bronfin, and others, regard it as innocuous, except in cases with fever of recent hemorrhage. Iglauer has made this noteworthy of observation: that in two cases of chronic pulmonary tuberculosis in which sputum examination had been negative repeatedly for a long time, promptly after the injection of lipiodol numerous tubercle bacilli were found. The subsequent course of these cases was not influenced adversely.

Mosher calls attention to inundation, or saturation areas, that he calls false abscess, resulting from bronchoscopic injections of lipiodol, that closely simulate real abscess. Here the parenchyma is flooded by the injection. He suggests that weaker injections of lipiodol must be used or, better still, that the oil must be introduced with a nebulizer, and he is working on this phase of the problem.

These facts need emphasis: first, that lipiodol must be adequately introduced; second, that there must be competent interpretation of the films.

SINUS SUPPURATIONS—THEIR SURGICAL TREATMENT *

By J. FRANK FRIESEN, M. D.
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DISCUSSION *by Edward C. Sewall, M. D., San Francisco; F. H. Brandt, M. D., Los Angeles, Frank A. Burton, M. D., San Diego.*

IN reviewing the literature on the surgical treatment of frontal sinus suppurations, one is impressed by the fact that there is a great difference of opinion in the procedure of treating these infections. Certain rhinologists seem universally successful with the intranasal operation and are apt to criticize colleagues who prefer operating by the external route. Fortunately most acute frontal sinus infections are of a mild character and recover without surgical intervention. In the majority of those who require surgical aid effective drainage can be insured by enlarging the frontoethmoidal passage intranasally; this should be the operation of choice in the uncomplicated simple suppurative process. Structural alterations in the anterior end of the middle turbinate, polypi, granulations, or a nasal septum deviated to the affected side, may interfere with proper drainage and should be corrected.

INDICATIONS FOR EXTERNAL OPERATION

The question arises as to when external operation is to be preferred. The anatomical and pathological condition of the sinuses should be studied from all angles. Sinuses do not drain well if the roentgenograms show them to be large, with backward extension along the orbital wall. Incomplete septa give rise to the formation of pockets and recesses, which interfere with the cure in chronic suppurations. Pathologic changes affecting the mucous membrane, periosteum, and bone, call for eradication of the lesion by an external method. Conservative measures should not be attempted in the presence of cerebral and orbital complications. Conservatism is often used to cover a timidity or a surgical insufficiency. An external operation is not a dangerous procedure, nor is it necessary to produce an unsightly scar. Success depends upon good surgical judgment and employment of the proper technique in the type of operation performed.

TYPES OF OPERATION

When only one frontal sinus is affected the Lynch[1] operation has given me good results. In one of the cases here reported, where an attempt had been made to carry out the Lynch technique, failure was due to incomplete removal of the anterior ethmoid cells, and to a collapse of the outer wall of the nasofrontal passage, as the result of a large resection of the orbitonasal bones.

Another operation commonly used is the Killian,[2] but so many failures are reported that it is in disrepute. The aim in Killian's operation is to remove all diseased tissue and bring about an

* Read before the Eye, Ear, Nose, and Throat Section, California Medical Association, at its Fifty-Sixth Annual Meeting, April 25-28, 1927.